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Comparisons of Revenue Estimates between Data from Costs and Earnings Surveys and Data from the Catch-Effort Statistical System for Selected Gear Types in 1985 and 1986

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Comparisons of Revenue Estimates between Data from Costs and Earnings Surveys and Data from the Catch-Effort Statistical System for Selected Gear Types in 1985 and 1986

D. Murphy and R. Shotton
Program Coordination and Economics Branch,
Fisheries and Oceans, Scotia-Fundy Region,
Box 550, Halifax, Nova Scotia
B3J 2S7

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Abstract

The Catch-Effort Census is the basis for fisheries statistical information but nothing is known about the extent of possible bias in results from this system. This analysis compares revenue values that were obtained from Costs and Earnings surveys of 13 different fisheries in 1985 and 1986 with the values from the Catch-Effort Census for the corresponding vessels. The two mean vessel revenue values ranged in agreement from 0.3% to 14.2%. If revenues assigned to unknown vessels in the Catch-effort Census are considered, the range becomes 2.5% to 12.6%. When Catch-effort Census data can be corrected for unidentified landings, agggregate fleet revenues are within 3.2% of the Costs and Earnings estimates. We conclude that such comparisons provide a useful guide to the accuracy of the relevant Catch-effort Census statistics.

Key words: fisheries statistics, fisheries catch-effort statistics, fisheries costs and earnings statistics, accuracy of fisheries statistics

Resumé

Le recensement des prises et effort forme la base de l'information statistique sur les pêcheries mais rien n'est connue sur l'étendue du biais possible dans les résultats provenant de ce systéme. Cette analyse compare les revenus obtenues de l'enquête sur les coûts et revenus de 13 différentes pêcheries en 1985 et 1986 avec les valeurs obtenues, pour les mêmes bateaux, du système de prises et effort. La différence du revenu moyen par bateau s'étend entre 0.3% et 14.2%. Cependant si l'on tient compte du revenu associé aux bateaux non identifiés dans le recensement des prises et effort, l'étendue devient 2.5% à 12.6%. Pour l'ensemble de la flotte, la différence n'est que de 0.8%. Il est conclu que cette comparaison fournie un guide utile pour estimer la justesse des statistiques de recensement sur les prises et effort.

Mots-clé: statistiques des pêches, statistiques des efforts-de-prise des pêches,statisques des coûts et revenues des pêches, exactitude des statistiques des pêches.

1. INTRODUCTION

The Statistics Division in Scotia-Fundy Region obtains data on vessel performance by collection of catch and revenue data through its slip-landings reporting system. Additional data on vessel performance are collected through annual costs and earnings surveys by the Economic Analysis and Marketing Section. Each year, these surveys focus on a number of specific fisheries. Because these surveys also collect data on vessel revenues, the revenue estimates can be compared to those from the Catch-effort Census to indicate the accuracy of reported vessel revenues.

Our experience is that that fishermen interviewed during the costs and earnings surveys usually confidently reported the value of their earnings but invariably were uncertain with regard to the amounts and species composition of their catch. Thus we do not believe that landings by weight obtained by the cost and earnings survey can be usefully compared with the corresponding weights obtained from the Catch-effort Census. However, should reasonable agreement exist between the two revenue values, it may be inferred that the weights of fish landings given by the Catch-effort Census are accurate.

In this analysis, revenues of vessels sampled by costs and earnings surveys in 1985 and 1986 are compared with their revenues as indicated by the Catch- effort Census. Two questions are examined, both on a specific gear-type basis:

1. Do the costs and earnings surveys give the same estimates of sample fleet revenues as that of the catch and effort census? and;
2. Under specific assumptions of fleet revenue reporting, how different are the two estimates of revenue for the different gear-category fisheries.

2. COMPARISON OF FISHERY REVENUE ESTIMATES

2.1 Methods

Revenue values for the vessels selected by the costs and earnings survey were compared with the corresponding values from the catch-effort census. The costs and earnings surveys, which are supervised by D. Murphy, Economic Analysis and Marketing Division, Scotia-Fundy, obtain data on annual costs and earnings together with other vessel performance data by interviewing vessel owners, or if appropriate, vessel operators. Exact details of the survey methodology and results are given in DFO 1985 and DFO 1986. The fleet was stratified so as to create vessel subpopulations that were as homogenous as possible. Vessel revenue values from the Catch-effort Censuses were obtained from the sales slips that fish buyers must complete and return to the Department of Fisheries and Oceans.

Because the vessels sampled were selected according to a random design within strata, their mean revenue can be taken as an unbiased estimate of the fleet means for the respective gears. To test if there were significant differences between the two population values, a Wilcoxon matched-pairs signed-rank test was used. A non-parametric test was used to avoid invoking assumptions about the distribution of the paired-observation differences and because of the relatively few observations in some of the gear categories that were examined. For comparative purposes, a t-test of the paired differences was also done, despite these reservations.

A further value for vessel revenues was obtained by taking the maximum of the Catch-

effort Census value and that from the costs and earnings survey. The maximum values were then compared with the values from the other two sources. Implicit in this analysis is that the greater vessel revenue of any pair provides a better estimate of a vessel's earnings though no evidence exists that respondents under-reported their earnings to interviewers. This comparison provides an indication of a maximum error bound for fleet revenue estimates.

Many slips entered by the Catch-effort Census have no recorded Canadian Fishing Vessel (CFV) number or the CFV number given is known to be invalid or incorrect. Frequently the revenues represented by these slips cannot be correctly attributed to a specific vessel. However, the values, though unidentified by vessel, are included in the total estimates for the fisheries defined by the respective gear types. Thus estimates of mean vessel revenues based on a sample of specific vessels' receipts from the catch-effort census will be biased to the extent that revenues for that fishery have been unassigned or misassigned to particular vessels.

To account for landings not specified by CFV, the mean vessel values from the catch-effort census have been adjusted by the fraction of total revenues attributed to the "unspecified CFV" category. These adjusted values have been compared with those from the catch-effort census. One difficulty in making this correction is that while the type of fishery the slip applies to usually is evident, because the true CFV number is unknown, it is not possible to determine to which size class the revenue data applies. Thus the same fraction may be used for more than one gear category in this analysis.

2.2 Fleets Sampled

The 1985 gear categories that were sampled are:

4VW Groundfish Longliners 35'-64' - homeports in 4VW (statistical districts 1,4,6,7,8,9,14,15,16,17,18,19,20 or 21) which reported a landed value ≥ $10,000 and which used longline gear to land 80% or more of their landed value.

4VW Groundfish Mobile Gear 35'-44' - Vessels with homeports in 4VW which reported a landed value ≥ $10 000 and which used mobile gear to land groundfish of 80% or more of their landed value.

4VW Groundfish Mobile Gear 45'-64' - As above, but with greater length.

4Vn Lobster - Vessels less than 65' with homeports in 4Vn (statistical districts 1,4,6 or 7) which reported a landed value ≥ $10 000 with lobster comprising 80% or more of the landed value.

4Vn Multi-Purpose - All remaining vessels less than 65' with homeports in 4Vn which reported a landed value ≥ $10 000.

4W Lobster - Vessels less than 65' with homeports in 4W (statistical districts 8,9,14,15,16,17,18,19,20 or 21) which reported a landed value ≥ $10 000 with lobster comprising 80% or more of the landed value.

4W Multi-Purpose - All remaining vessels less than 65' with homeports in 4W which

reported a landed value ≥ $10 000.

4X Groundfish Longliners 35'-44' - Vessels with homeports in 4X (statistical districts 22-28, 30-44, 46-53, 79 or 81) which reported a landed value ≥ $10 000 and which used longline gear to and 80% or more of the vessel's landed value.

4X Groundfish Longliners 45'-64' - Vessels with homeports in 4X which reported a landed value ≥ $10 000 and which used longline gear to land 80% or more of the landed value.

4X Groundfish Mobile 35'-44' - Vessels with homeports in 4X which reported a landed value ≥ $10 000 and which used groundfish mobile gear to land 80% or more of the landed value.

4X Groundfish Mobile 45'-64' - Vessels with homeports in 4X which reported a landed value ≥ $10 000 and which used groundfish mobile gear to land 80% or more of the landed value.

The total number of Scotia-Fundy vessels fitting these criteria in 1985 was 927; 318 were randomly selected to be interviewed and 214 completed questionnaires were obtained. For the analyses of the 1986 data, six classes of vessels were sampled. Vessels with a Bay of Fundy scallop license and with landings in 1986 ≥ $10 000 were divided into those whose landings were almost exclusively composed of scallop (scallop specific); and those whose landings were mostly groundfish (groundfish specific). The other four classes consisted of inshore vessels (less than 45') with total landed value ≥ $10,000 and which operated from a homeport in one of Lobster Fishing Areas 34, 35, 36 or 38.

The inshore vessels were grouped into four classes based on the homeport location. Included in the inshore vessel samples were "7-mile Scallopers", vessels landing only lobster, and various multi-purpose vessels. The inshore class excluded vessels ≥ 35' that specialized in groundfish; vessels < 35 specializing in groundfish were included. The number of vessels meeting the population criteria was 1331. From these a sample of 210 was randomly selected and 139 interviews were completed. The number of vessels in each fishery for which data were obtained are shown in Tables 1 and 2.

3. RESULTS

Table 3 shows the various fleet revenue comparisons. In all categories, relatively few individual vessel results were identical from the two sources; the best result was for the 4Vn multipurpose fleet in which 52% of observations agreed exactly; the worst case was for 4W lobster in which only 10% of observations were identical. In all cases, the incidence of higher individual vessel revenue values was greater for the costs and earnings data than that for the Catch-effort Census. This is indicated in Figures 1-8 which show histograms of the distribution of the difference values.

In all but one gear category, the mean vessel revenue estimated by the costs and earnings survey was greater than that given by the Catch-effort Census. For the 1985 data comparisons, the maximum difference (12.9%) occurred for the 4W multipurpose fleet, followed by the 4X longline fleet (12.8%). The 4X longline fleet was the single mean vessel-revenue estimate for which the costs and earnings value was lower than that given by the Catch-effort Census.

TABLE 1

SAMPLE POPULATIONS IN 1985 COSTS AND EARNINGS SURVEY

Fishery	Number of Vessels in Population	Number Sampled	Refusals or Ineligible	Completed Interviews	%
4VW longline 35'-64'	54	30	9	21	38.9
4 VW mobile 35'-44'	20	20	8	12	60.0
4 VW mobile 45'-64'	14	14	7	7	50.0
4 VN lobster	256	30	11	19	7.4
4 VN multipurpose	115	35	8	27	23.5
4 VW lobster	85	30	8	22	25.9
4 W multipurpose	111	35	12	23	20.7
4 X longline 35'-44'	75	30	16	24	32.0
4 X longline 45'-64'	37	34	16	18	48.6
4 X mobile 35'-44'	86	30	10	20	23.3.
4 X mobile 45'-64'	74	30	9	21	28.4
Total	927	318	104	214	

TABLE 2

Sample Populations Surveyed in 1986

Fleet Classes	[1]Number of Vessels in Population	Number Sampled	Number of Refusals or incomplete Interviews	Completed Interviews	%
Inshore South N.B. (Lobster Fishing Area 36)	100	30	13	17	15.7
Inshore Grand Manan (Lobster Fishing Area 38)	98	30	8	22	23.9
Inshore Inner Fundy (Lobster Fishing Area 35)	73	20	6	14	19.2
Inshore West N.S. (Lobster Fishing Area 34)	847	100	34	66	0.6
Total	1118	180	61	119	
Bay of Fundy With Scallop License	92	30	10	20	21.7

In the analysis all inshore vessels have been treated as a single sample.

[1]The population sizes reported in this Table are the most recent obtained from the Catch-effort system. Because of revisions to the vessel data base they may vary slightly to those reported in DFO 1985 and 1986.

Table 3
Vessel Revenue Comparisons

Fishery	Total	No. of Identicle Values[1]	Mean Vessel Revenue ($) Catch-Effort Census Sample	Cost & Earnings Survey Sample	Maximum Difference	Mean Absolute Difference	Maximum Positive Difference	Mean Positive Difference	Maximum Negative Difference	Mean Negative Difference
4VW Longline 35-64	21	6	82 970	88 007	56 227	12 710	56 227	16 450	-21 970	-7 086
4VW Mobile 35 - 44	12	5	127 322	133 354	30 320	11 069	30 320	12 490	-2 549	-2 549
4VW Mobile 45 - 64	7	2	240 432	250 724	49 958	20 460	49 950	21 593	-15 129	-15 129
4Vn Lobster	19	2	29 056	29 130	-14 983	3 563	10 848	3 100	-4 226	
4Vn Multipurpose	27	14	29 093	30 106	10 000	3 005	10 000	3 020	-4 105	-2 922
4W Lobster	21	2	15 527	[2]10 140	-26 077	3 946	6 010	3 143	-26 077	-6 193
4W Multipurpose	23	4	25 279	28 545	16 615	4 450	16 615	6 659	-2 371	-604
4X Longline 35 - 44'	23	10	122 137	[2]119 836	-55 582	8 618	13 929	3 695	-55 582	-16 495
4X Longline 45 - 64'	10	7	279 510	315 340	235 107	85 516	235 107	99 159	-119 456	-49 135
4W Mobile 35 - 44'	20	4	156 329	157 163	-57 947	12 347	25 848	11 902	-57 947	-12 917
4X Mobile 45 - 64'	21	4	309 224	323 994	121 496	25 025	121 496	33 435	-33 435	-9 605
Inshore Less than 45'	116	2	61 993	67 901	142 025	17 357	142 025	19 029	-83 246	-14 698
Trawlers with scallop Licence	20	0	103 996	210 024	291 446	33 286	291 446	42 395	-36 649	-12 030

[1] These numbers are those vessles for which the Catch-Effort and Costs and Earnings Survey figures were the same.
[2] These values differ slightly from those reported in DFO 1985 as an updated data base has been used.

DIFFERENCE = COSTS/EARNINGS VALUE MINUS
CATCH & EFFORT SURVEY VALUE

FIGURE 1
4VW LONGLINERS (35'-64')

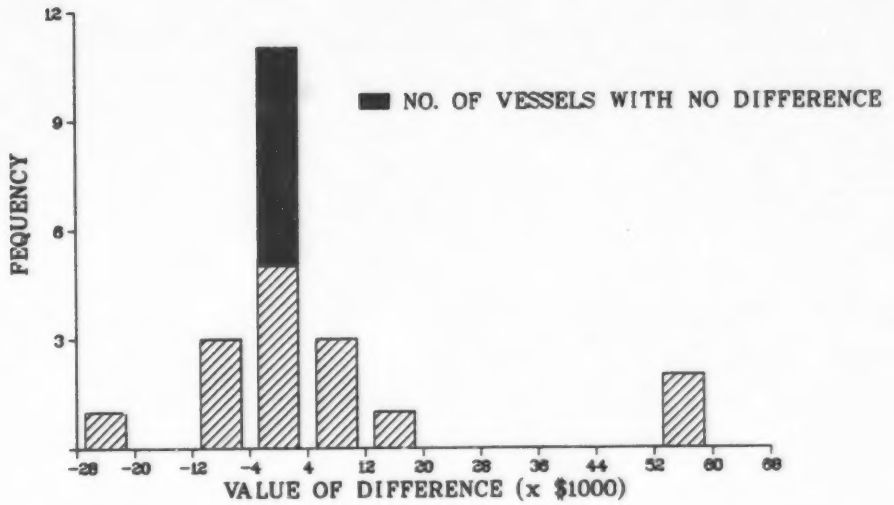
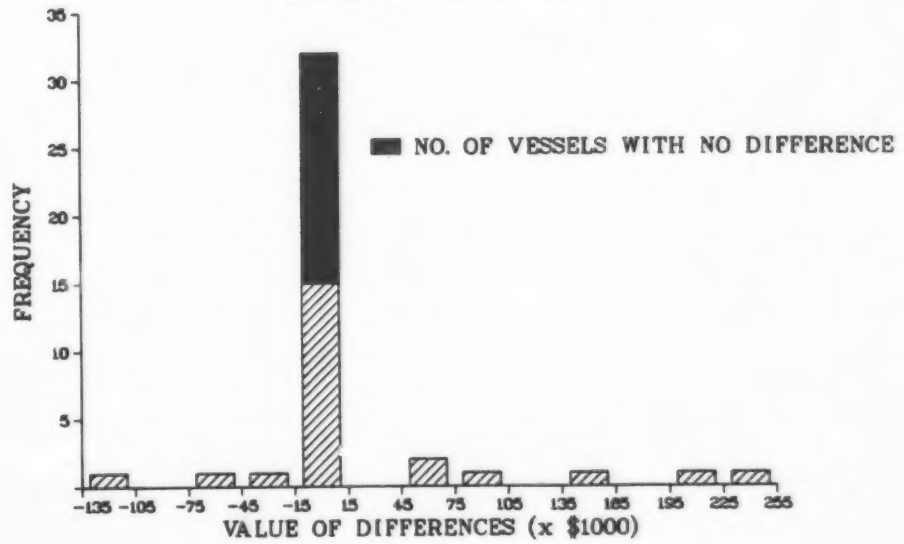


FIGURE 2
4X LONGLINERS (35'-64')



DIFFERENCE = COSTS/EARNINGS VALUE MINUS
CATCH & EFFORT SURVEY VALUE

FIGURE 3
4VW MOBILE GEAR

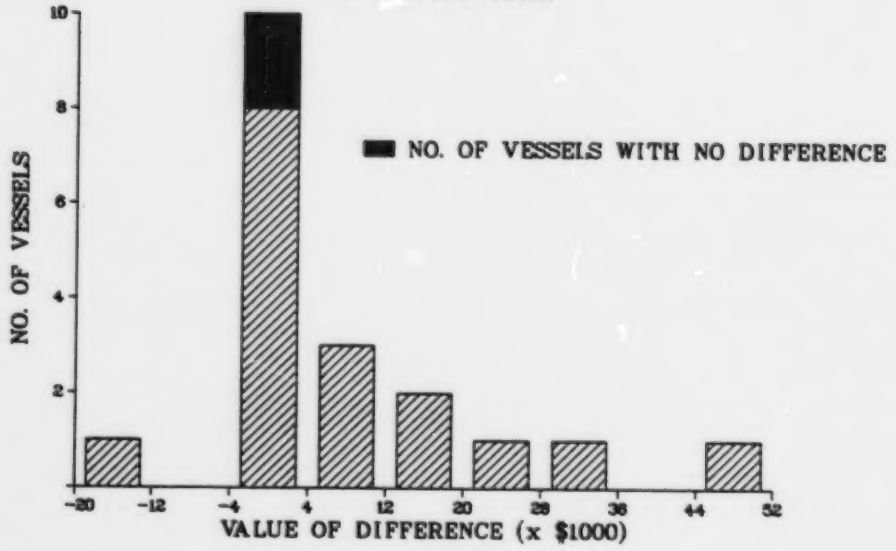
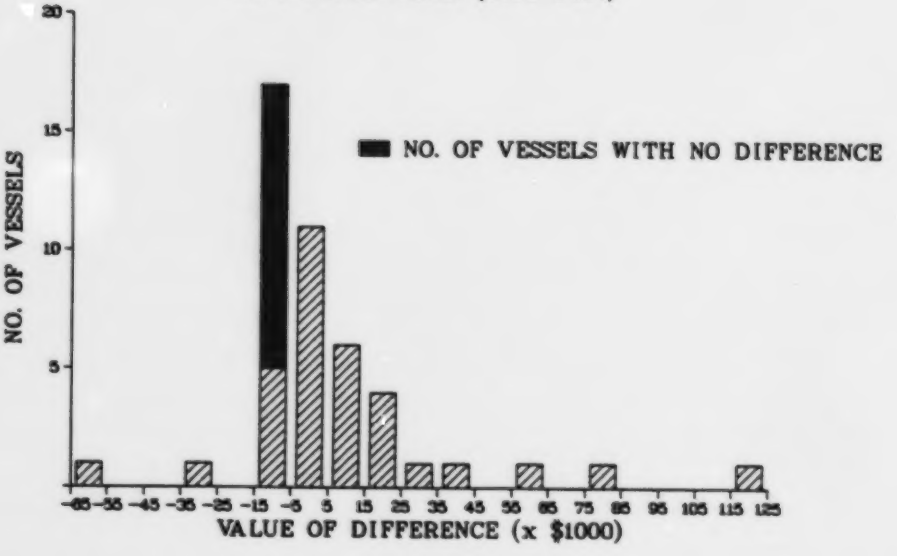


FIGURE 4
4X MOBILE GEAR (35ft–64ft)



DIFFERENCE = COSTS/EARNINGS VALUE MINUS
CATCH & EFFORT SURVEY VALUE

FIGURE 5
MULTIPURPOSE GEAR

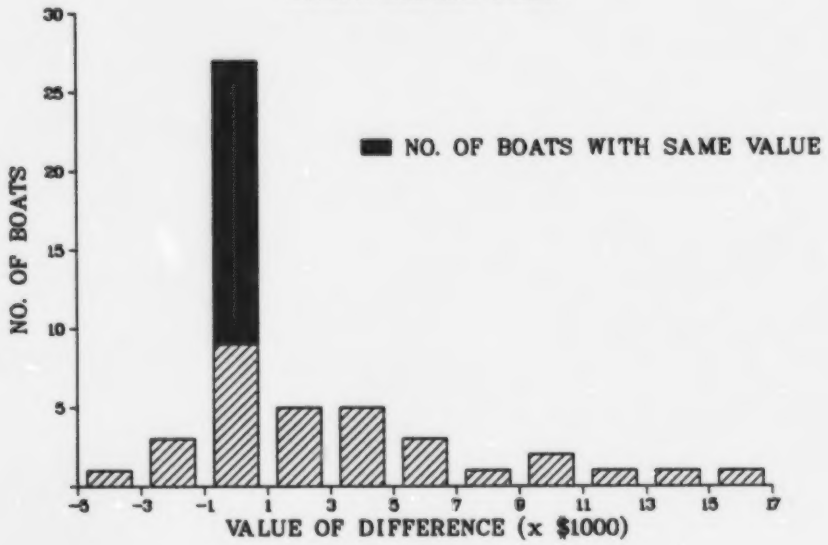
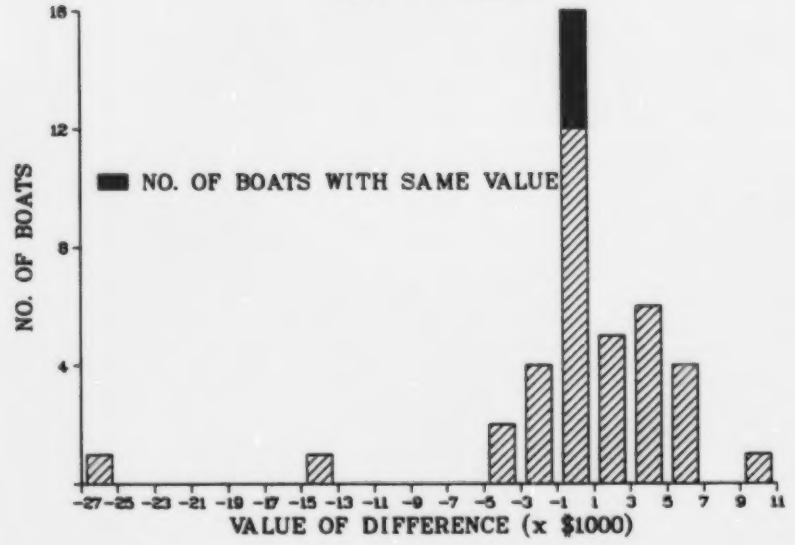


FIGURE 6
AREA 4 LOBSTER



DIFFERENCE = COSTS/EARNINGS VALUE MINUS
CATCH-EFFORT CENSUS VALUE

FIGURE 7
INSHORE GEAR (<45')

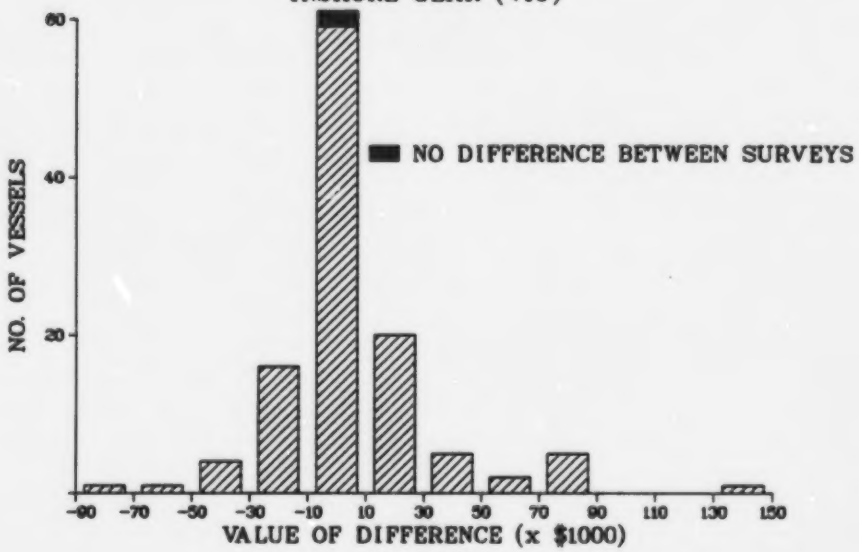
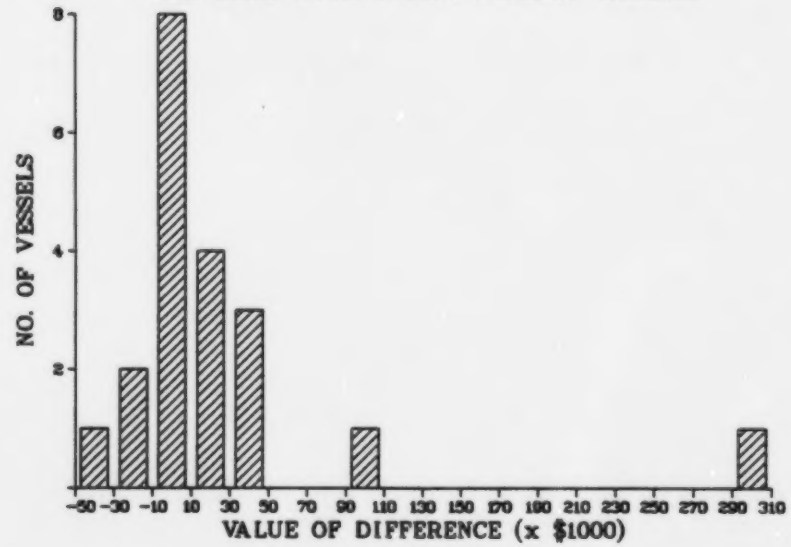


FIGURE 8
TRAWLERS WITH FUNDY SCALLOP LICENCE



In absolute terms, some of the individual paired differences between the two values were enormous. These ranged from nearly one quarter of a million dollars in one case in the 4X longline 35' - 44' category, to $10 000 in the case of the 4Vn multipurpose fishery. In seven of the eleven gear categories examined the greatest difference was positive (i.e. 'Costs and Earnings' estimate > 'catch effort' census), in four situations the greatest difference was negative. The mean of the positive differences (excluding vessels in which the two estimates were identical) by gear type, ranged from $99 159 to $3020, (for the 4X longline 35'- 44' and 4Vn multipurpose categories respectively); the range of the negative differences ranged from $119 456 (4X longline 35' - 44') to $2371 (4W multipurpose).

The infrequence of identical observations from the 1986 survey followed the 1985 pattern. In the inshore sample only 2 of 116 vessels gave similar vessel revenues for the two values and none were the same in the case of the scallopers. Again the estimate of the mean vessel revenues obtained by the costs and earnings survey were greater than those from the catch and effort census, 9.5% in the case of the inshore class, and 14.2% in the case of the "trawlers with scallop licence" gear category. In both cases the extremes of the differences between vessel estimates was large (see Figures 7 and 8); $142 025 for the inshore class and $291 446 for the 'scallopers'.

Figures 9 and 10 show box plots of the differences of the two estimates. The range of the difference values are shown by the T-bars, while the boxes show the range of the differences between the 25th and 75th quartiles. In Figure 9, the box plot frequencies include the observations in which the two estimates for a single vessel were the same; in Figure 10, they have been excluded. This has the effect of increasing the interquantile range as there are fewer centrally-located values.

Table 4 lists the results from the Wilcoxon paired-differences signed-rank comparisons, and the t-tests for paired differences. The non-parametric test indicates that a null hypothesis of:

$$H_0 : U_{ce} = U_{ce}$$

where U_{ce} = fleet mean estimate from catch and effort census,
and U_{ce} = fleet mean revenue estimate from the costs and earnings survey,

i.e. both regimes were the same, could be rejected for the 1985 data in three cases, that for the 4Vn multipurpose fleet, 4W lobster, and 4X longliners, 45' - 64'. In the other eight (1985) gear categories, the two methods (catch-effort census and costs and earnings survey) can be taken as giving the same fleet revenue estimates.

The results for the paired-observations t-test were rather different. In only one category - 4Vn multipurpose - did both tests show a significant difference between the two fleet mean revenues. The t-test showed a difference for the 4VW mobile 35' - 44' category, but the few observations (12) make this result unreliable. The other significant difference was for the 4X mobile 45' - 65' category for which degrees of freedom was 20, still rather low for such a test. For the two 1986 gear categories, both cases showed a significant difference between the mean revenues from the two sources, even though, in the case of the inshore category, the

FIGURE 9

BOX PLOT OF DIFFERENCES BY GEAR TYPE

INCLUDING 'NO-DIFFERENCE' DATA

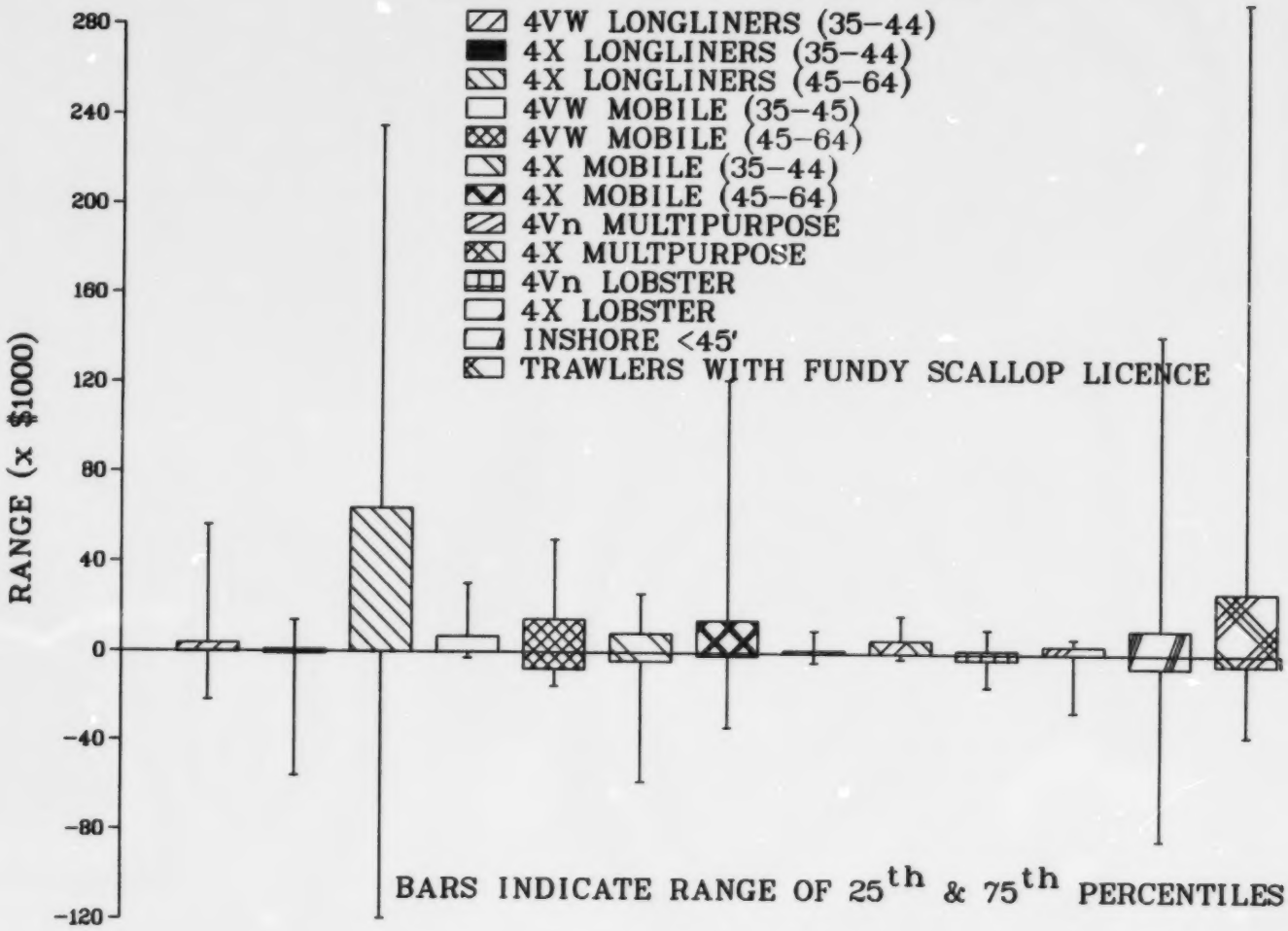


FIGURE 10

BOX PLOT OF DIFFERENCES BY GEAR TYPE

EXCLUDING 'NO-DIFFERENCE' DATA

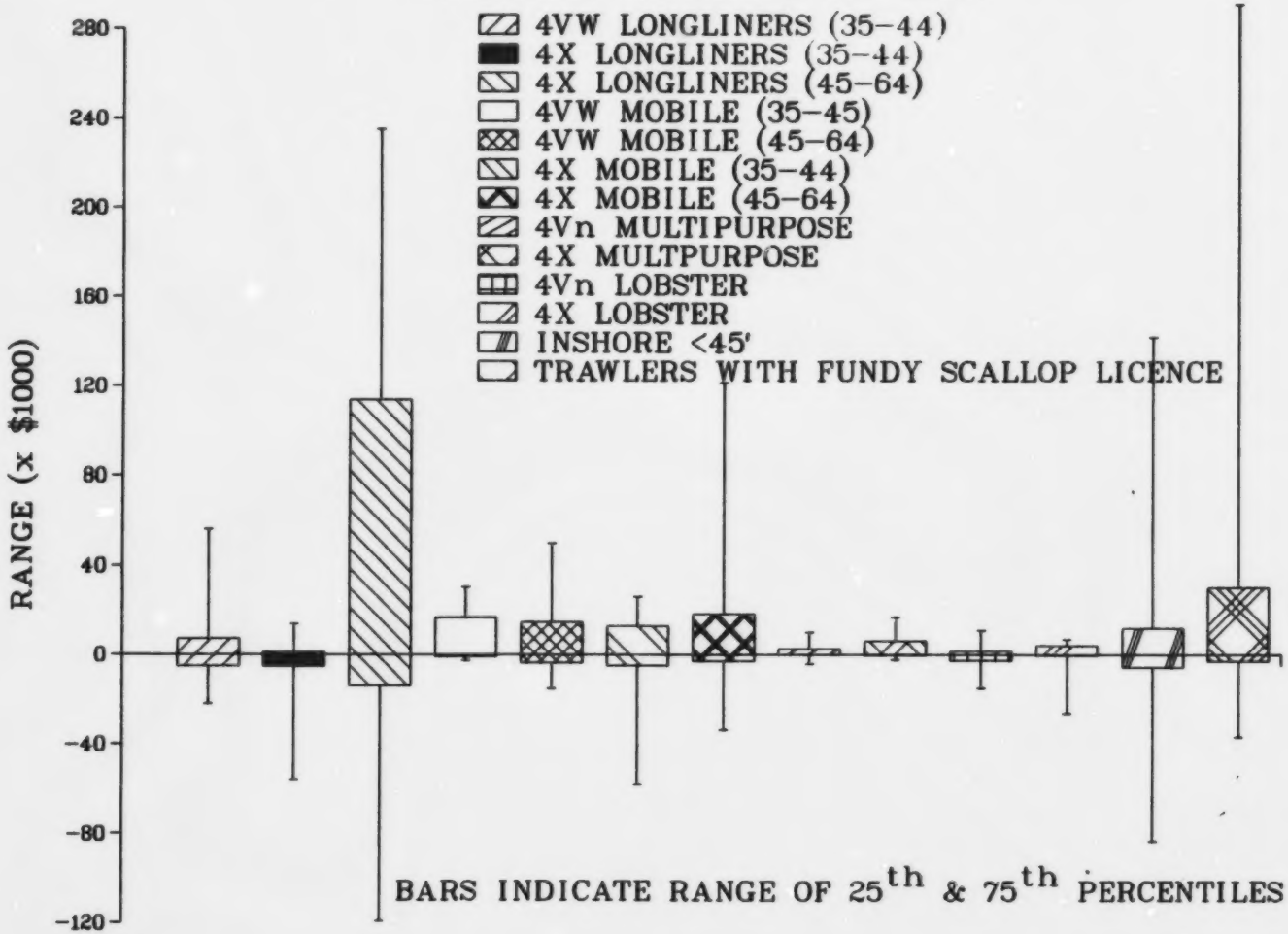


Table 4

Results from Wilcoxon Matched-Pairs Signed-Rank Test and T-Test of Differences Between the Catch-Effort Census and Costs and Earnings Survey Estimates of Vessel Revenues

Gear Category		Wilcox Test Results: Critical value; if observed summed paired ranks is less than critical value, Reject H_o: no difference	Wilcox Test Results: Observed summed paired ranks.	T-Test Results: P-value from t-test H_o : difference = 0	T-Test Results: df
4 VW Longline	35'-64'	25	51	0.22	20
4 VW Mobile	35'-44'	2	4	0.07	11
	45'-64'	0	4	0.23	6
4 VN Lobster		55	0.95	18	
4 VN Multipurpose		17	*14	0.08	26
4 W Lobster		46	*38	0.67	20
4 W Multipurpose		46	74	0.27	22
4 X Longline	35'-44'	17	38	0.39	22
	45'-64'	40	*20	0.28	17
4 X Mobile	35'-44'	30	51	0.83	19
	45'-65'	35	51	0.07	20
Inshore	< 45'1	Z = -24.9	p < 0.01	0.03	115
Trawlers with Fundy Scallop licence		30	6*	0.10	19

*/ Indicates a significant difference, p = 0.05, two-tail test.

1/ For large sample tests, the Wilcoxon method determines a statistic that has a Z distribution.

difference was not large.

Table 5 lists ratios of the mean vessel revenues from the costs and earnings survey to that from the catch-effort census and the ratio of the maximum revenue values to the two other values. Of the costs and earnings to catch-effort census ratios, the greatest difference was 12.9% in the case of the 4W multipurpose fishery. The simple mean of the percentages was 5.5%. For the 1986 ratios a 14.2% difference occurred in the case of the 'scallop licence' vessels and 9.5% in the case of the inshore class. With the ratio of the maximum revenue value and the 'costs and earnings' value, the greatest difference in 1985 was 8.1% for the 4W lobster fishery, and in 1986, 8.2% for the inshore catagory. The simple mean of the values in 1986 was 2.5%.

In the case of the ratios of the maximum values to the catch-effort values, the greatest difference was 15.8% for the the 4X longline, 45'-64' fleet. Other gear categories with moderately large differences were the 4W multipurpose sector, 13.7%, and the 4W lobster, 12.0%. In eight of the gear categories, the difference between the catch and effort value, and that obtained, if the maximum revenue reported was used, was less than 10%; the simple mean of the differences was 7.3%; this compares with 5.5% for the ratios of the 'catch and effort' census values and the costs and earnings estimate.

Table 6 lists the fleet revenues that would be obtained for each gear category, using the three different mean-vessel revenue estimates (unadjusted catch-effort census, costs and earnings survey, and the maximum value of these). The greatest estimated absolute difference in fleet revenues occurred in the mixed fleet, <45', west of Baccaro category. Columns 2 and 3 of Table 6 list the mean vessel revenues for the entire fleets based on the catch-effort census and those for the vessels selected for the survey.

In seven of the thirteen catagories the mean from the sample was smaller than the mean from the census. The eigth and ninth columns show the fleet revenue estimates based on the respective mean revenue estimates and fleet sizes. For the 1985 data the 4X longline 45' - 64' catagory had the largest difference; in 1986 the largest difference was for the inshore, <45', west of Baccaro fleet.

Table 7 shows the incidence of unidentified slips and the fraction of total revenues they represent. In 1985 the incidence of revenues unattributable to specific CFV numbers ranged from 5.7% (4X Mobile gear) to 12.8% (4 Vn lobster). Because vessel lengths can not be determined when CFV numbers are unknown, no analysis was possible for the inshore catagory.

Table 8 shows the results of adjusting the respective fleet mean vessel revenue estimates by these amounts. The 1985 figures from Table 6 have been used for the 1985 comparisons. The ratio of the 'costs and earnings' to catch-effort census values is also shown after recomputing the denominator to account for the non-attributed earnings.

Of the 9 gear categories for which comparisons are possible, adjusting for unidentified slips resulted in eight costs and earnings gear estimates being lower than those from the catch-effort census. The greatest difference is for the 4Vn Lobster fishery, (-12.5%). The previous greatest difference - 12.8% for the 4X Longliners, 45' - 65' reduces to 5.0%. A simple arithmetic mean of the differences for the 9 gear catagories that were adjusted (from Table

Table 5

Ratios of Revenues

Gear Category		Ratio of Costs & Earnings to Catch-Effort	Ratio of Maximum Revenue Value to Costs & Earnings	Ratio of Maximum Revenue Value to Catch-Effort
4VW Longliner	35'-64'	[1]1.061	1.023	1.085
4VW Mobile	35'-44'	1.047	1.002	1.049
4VW Mobile	45'-64'	1.043	1.009	1.052
4VN Lobster		1.003	1.053	1.056
4VN Multipurpose		1.035	1.007	1.042
4W Lobster		1.035	1.081	1.120
4W Multipurpose		1.129	1.007	1.137
4X Longliner	35'-44'	0.981	1.030	1.011
4X Longliner	45'-64'	1.128	1.026	1.158
4X Mobile	35'-44'	1.005	1.029	1.034
4X Mobile	45'-64'	1.048	1.008	1.057
Simple mean of averages:				
		5.53%	2.50%	7.28%
Inshore	< 45'	1.095	1.082	1.185
Trawlers with Fundy Scallop licences 1.142		1.017	1.161	
Simple mean of averages:		11.8%	5.0%	17.3%

[1]/ This is equal to a Costs and Earnings value 6.1% greater than the Catch-Effort figure.

Table 6

Total fleet revenue estimates based on Catch and Effort censuses and Costs and Earnings survey, and maximum revenue. All vessels had gross revenues in 1985 or 1986 of more than $10 000.

Gear Catagory	Fleet Size[1]	Mean Revenue Based on Catch-Effort Census: Census[2]	Mean Revenue Based on Catch-Effort Census: Sample[3]	Costs and Earnings Survey	Difference Between Survey and Census	Fleet Mean, Maximum Revenue	Max. Rev. Difference to Catch-Effort	Fleet Revenue: Catch-Effort Census	Fleet Revenue: Costs & Earnings	Difference Between Two Fleet Revenues	Rank of Total Difference
4W Longline 35' - 64'	55	102 071	82 978	88 007	5 029	90 032	7 054	4 563 790	4 840 385	276 595	6
4VW Mobile 35' - 44'	26	127 131	127 322	133 354	6 032	133 566	6 244	3 310 372	3 467 204	156 832	9
4VW Mobile 45' - 64'	15	276 822	240 432	250 724	10 292	252 886	12 454	3 606 480	3 754 110	147 630	10
4Vn Lobster	258	27 018	29 056	29 130	74	30 687	1 631	7 496 448	7 515 540	19 092	13
4Vn Multipurpose	119	31 746	29 093	30 106	1 103	30 323	1 230	3 462 067	3 582 614	120 547	11
4W Lobster	84	18 018	15 527	18 148	2 621	19 623	4 096	1 304 268	1 524 432	220 164	7
4W Multipurpose	110	25 237	25 279	28 545	3 266	28 753	3 474	2 780 690	3 139 950	359 260	5
4X Longline 35' - 64'	77	134 198	122 137	[3]119 836	-2 301	123 422	1 285	9 404 549	9 227 372	-177 177	8
4X Longline 45' - 64'	39	266 279	279 518	315 340	35 822	323 589	44 071	10 901 202	12 298 260	1 397 058	3
4X Mobile 35' - 44'	80	150 228	156 329	157 163	834	161 865	5 536	12 506 320	12 573 040	66 720	12
4X Mobile 45' - 64'	74	280 251	309 224	323 994	14 770	326 738	17 514	22 882 576	23 975 556	1 092 980	4
Mixed Fleet <44', West of Baccaro	1118	71 595	61 993	67 901	5 908	73 476	11 483	69 308 174	75 913 318	6 605 144	1
Trawlers with Bay of Fundy Scallop Licence	94	196 671	183 996	210 024	26 028	213 663	29 637	17 295 624	19 742 256	2 446 632	2
								[1]68 882 560	181 554 037	12 731 447	
								(7.5% difference)			

[1]/ These values may vary slightly to those reported in DFO 1985 and 1986 as an updated data base has been used.
[2]/ Based on all vessels in the gear catagory population.
[3]/ Based on revenues for the vessels selected for the sample.

Table 7

Incidence of Unidentified Slips by Gear Category

Gear Category	1985			1986			1987		
	Total no. of slips	% of Slips Unident.	% of Total Revenue Unident.	Total no. of slips	% of Slips Unident.	% of Total Revenue Unident.	Total no.of slips	% of Slips Unident.	% of Total Revenue Unident.
4 VW Longline	6 835	5.92	8.69	8 080	5.17	7.18	10 500	8.70	11.12
4 VW Mobile	1965	5.78	o.91	2 625	5.05	5.90	2 881	8.41	9.24
4 Vn Lobster	17 624	5.41	12.8	19 863	4.84	10.11	22 106	9.46	16.18
4 VN Multipurpose	No analysis possible as lengths unknown								
4 W Lobster	8 483	5.86	7.02	9 179	5.10	6.03	7 350	9.00	8.43
4 W Multipurpose	No analysis possible as lengths unknown								
4 X Longline	5 575	5.95	6.94	5 549	5.07	5.76	7 350	9.00	8.43
4 X Mobile	11 767	5.05	5.67	11 133	4.56	5.07	10 904	8.03	7.39
Inshore < 45'	No analysis possible as lengths unknown								
Trawlers with Fundy Scallop License*	No analysis possible as lengths unknown								

* The unidentified 4X vessels with scallop landings will not coincide directly with the population selected for the costs and earnings survey. The unidentified earnings should be an upper limit.

Table 8

Fleet Mean Revenue Estimates Adjusted for Incidence of Unidentified Vessel Revenues

Gear Type	Ratio of[1] Costs and Earnings to unadjusted Catch-Effort Values	Ratio of Costs and Earnings to adjusted Catch-Effort Values	2% Difference	Fleet Revenues Costs and Earnings	Fleet Revenues Catch-Effort, Adjusted for Unidentified Landings
4VW LL 35'-64'	1.061	0.968	-3.2	4 840 385	4 998 127
4VW Mobile 35'-44'	1.047	0.975	-2.5	3 467 204	3 556 098
4VW Mobile 45'-64'	1.043	0.971	-2.9	3 754 110	3 874 186
4Vn Lobster	1.003	0.874	-12.6	7 515 540	8 596 844
4W Lobster	1.035	1.087	8.7	1 524 432	1 402 740
4X Longliners 35'-44'	0.981	0.913	-8.7	9 227 372	10 105 898
4X Longliners 45'-64'	1.128	1.050	5.0	12 298 260	13 258 052
4X Mobile 35'-44'	1.005	0.925	-5.2	12 573 040	13 258 052
X Mobile 45'-64'	1.048	0.975	-1.2	23 975 556	24 258 005
Difference between two totals = 3.17%				79 175 899	81 764 116

[1] Adjusted for revenues not identified by CFV.

[2] $\frac{\text{(Costs and Earnings) - (Adjusted Catch-effort)}}{\text{Adjusted-Catch Effort}} \times 100$

8) is -3.0%, compared with (+) 4.3% prior to adjustment. In terms of the relevant fleet revenues, when the catch-effort census figures are adjusted for the unreported revenue, the total of the census values becomes 3.17% greater than the fleet revenue total based on the costs and earnings survey, i.e., after adjustment, the agreement is relatively closer, though the greater aggregate revenue estimate is now given by the Catch-effort Census figures.

5. DISCUSSION

The primary purpose in undertaking this analysis was to determine the accuracy of the fishery revenue estimates obtained from the catch-effort census through use of a second, independent, method. There are two possible criteria by which to assess the level of agreement between the two values. The first is the incidence with which the gear category comparisons are identical. Thus whether the costs and earnings figure is higher or lower is immaterial. In only one case (4 Vn multipurpose) were a majority of observations (52%) identical, and the low incidence of identical values indicates that before a management regime that depended on exact individual vessel estimates (e.g., for enterprise allocations) was introduced, the causes for the frequent occurrence of differing vessel revenue values must be identified and rectified. These results are shown graphically in Figure 11.

A second criterion of the success of the Catch-effort Census is the accuracy with which it measures the total fleet revenue, and by inference, fleet catch. In this case, it is immaterial whether a catch is assigned to one vessel or another, as long as it is accounted for in the fleet total. For example, for catch estimates used in determining biological advice (TAC's), it does not matter whether one boat or another was responsible for the recorded landings. For a successful enterprise allocation scheme in contrast, it is essential that landings are correctly attributed to the vessel taking the catch. The absence of significant differences between the estimates from the Catch-effort Census and the costs and earnings survey in eight of the thirteen gear categories surveyed indicates that the errors that do occur, compensate, i.e. excess or deficient revenues could be caused by catches being attributed to the wrong vessel.

As part of the effort to determine why the differences existed between the catch-effort census and the costs and earnings survey estimates, the survey forms were reexamined for the vessels that gave the extreme positive and negative differences in each gear category. In the case of 4VW longline, 4 VW mobile 35'-44' and 45'-65', 4Vn multipurpose, 4W lobster and inshore < 44', no explanation was evident for the large differences that were observed. In the case of the 4 Vn lobster, 4W multipurpose, 4X longline (35'-44') (45'-64') and the two gear categories surveyed in 1986, the costs and earnings surveyers identified reasons that clearly made the catch-effort census figures suspect. A common observation was that when swordfish figured in the operations of the vessels, differences could be expected.

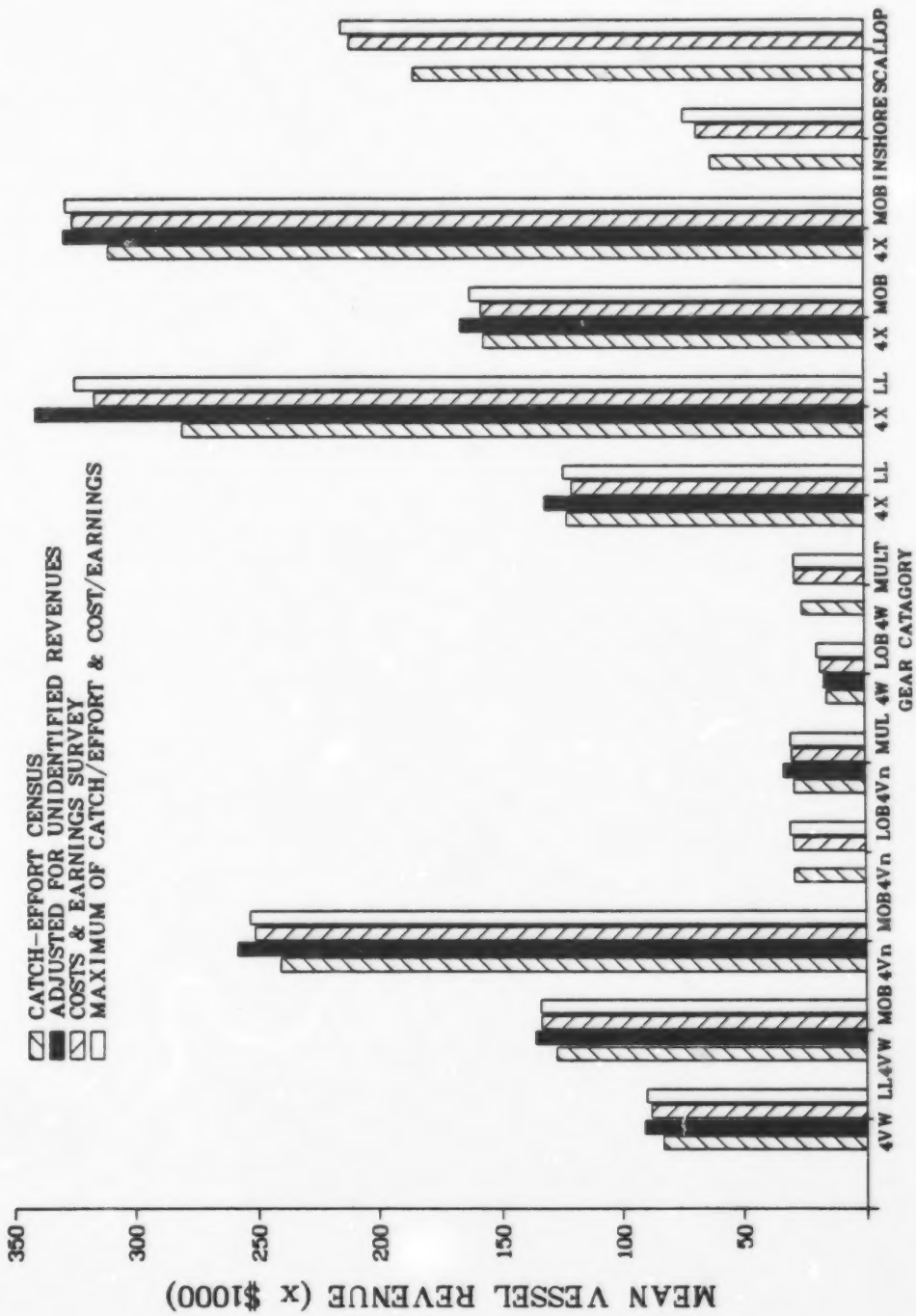
In one extreme case, confusion as to the currency (Canadian or U.S. dollars) existed; in another, no swordfish were present in the catch-effort census, indicating an unrecorded manner of product sales. However, whether an explanation of the differences between the two estimates is, or is not possible, these represent real differences, no matter what the cause. When explanations did seem possible, they were not amenable to a convenient or ready solution and their consequences must be considered endemic in the system.

A measure of the landings that will not be attributed to particular vessels, and thus will not be included in the unadjusted catch-effort census values is given by the value of the

FIGURE 11

MEAN VESSEL REVENUE ESTIMATES

FOR 13 GEAR TYPES



in another, no swordfish were present in the catch-effort census, indicating an unrecorded manner of product sales. However, whether an explanation of the differences between the two estimates is, or is not possible, these represent real differences, no matter what the cause. When explanations did seem possible, they were not amenable to a convenient or ready solution and their consequences must be considered endemic in the system.

A measure of the landings that will not be attributed to particular vessels, and thus will not be included in the unadjusted catch-effort census values is given by the value of the landings from slips that had unidentified CFV numbers. In these cases, though the specific vessels could not be determined; the point of landing is known. Thus fleet total estimates will not be in error if the general gear category can be identified. The results from Table 8 suggest that, if the unidentified revenues can be correctly allocated to fleets, then for most of the gear categories examined, there was a tendency for respondents to underestimate their earnings, the exceptions being the 4X Longliners 45'-64' and the 4W Lobster fleet.

On an aggregate basis, the close agreement (<9%) between fleet revenue estimates for 8 of the 9 gear categories that could be adjusted indicates that little may be achieved in correcting either estimate. When the catch-effort census value, even after correcting for unidentified landings, is lower than the costs and earnings estimate (4W lobster, 8.7%; 4X Longline 45'-64', 5.0%), then an upward change to fleet revenues may be appropriate. Should the adjusted Catch-effort Census value be used, then for the 9 gear types examined, the total fleet revenue would increase from the unadjusted value of $79 175 899 to $81 764 116 representing a 3.2% increase in the aggregate revenue estimate for the 9 gear catagories that could be adjusted. This indicates that better control of revenues reported to unidentifiable CFV numbers will give closer agreement between the catch-effort and costs and earnings estimates.

If the assumption is taken to use the maximum revenue estimate, then for the 9 gear catagories that could be adjusted, the Catch-effort Census value, in aggregate, underestimates the maximum value figure by 2.5%; the adjusted Catch-effort Census value underestimates the maximum value estimate by 0.9%.

6. LITERATURE CITED

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